Function Description Radiant Heater 600W

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1 Description of Radiant Heater 600 W

1.1 General description

1.1.1 Intended use

The RH 600 infant radiant heater is a radiant heater for keeping premature babies, neonates and infants, up to a body weight of 8 kg, warm.

It is intended for use in the delivery room, neonate unit, paediatric unit and paediatric intensive care units.

This apparatus must be operated by a doctor or by nurses or care assistants under the instructions of a doctor.

Therapeutic and care possibilities:

- Reanimation station
- Care station for normal and intensive care
- Warming and compensating for heat loss
- Weaning of incubator infants
- Timer for APGAR test

Heating possibilities of the RH 600 infant radiant heater:

- Operation of the radiant heater with set heat output: Radiant heater output controlled in manual mode, with treatment time monitored at higher heater outputs.
- Radiant heater operated with automatic skin temperature control: Skin temperature controlled and monitored.

Always maintain a minimum distance of 60 cm between the infant radiant heater and the bed. Otherwise, risk of burning the patient.

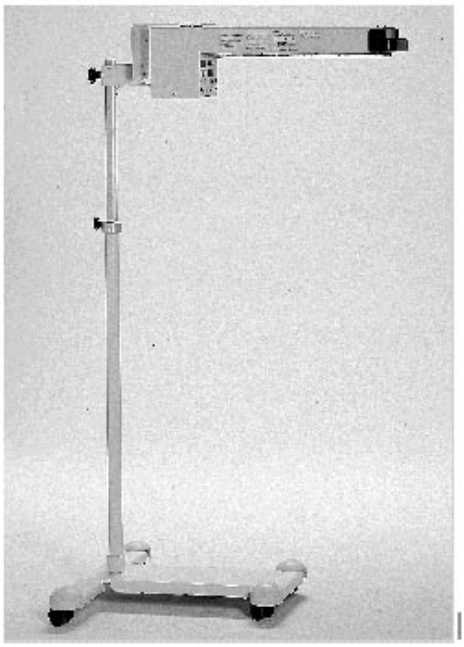
Do not use skin temperature control for patients in shock or with a high temperature.

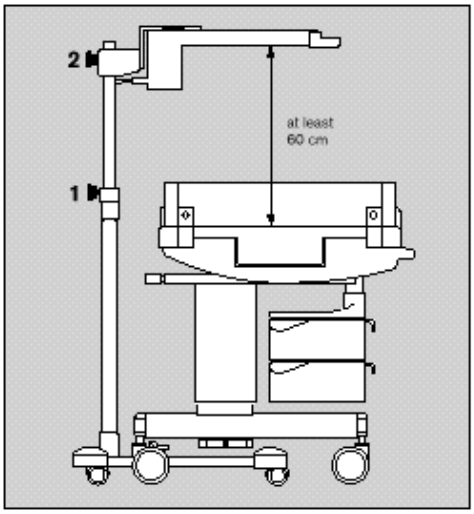
Do not use mobile phones within 10 metres of the apparatus.
Mobile phones can disrupt the function of electro-medical equipment and can thereby endanger the health or life of patients.

Installation options:

- Mounted on wheeled stand

- Wall-mounted





1.1.2 General functional description

The radiant heater consists of the heater housing and the control unit. A support 2M 19 302 is required if the heater is used in conjunction with the Babytherm 4200.

The heater housing accommodates four infrared ceramic lamps (150 watts each) and two low-voltage halogen lamp(s) (2 x 20 watts or 1 x 35 watts).

The alignment of the ceramic lamps is such that there is a high degree of uniformity to the heat distribution over the resting surface. The directional effect of the lamps makes for optimum illumination of the work area and thus for ergonomic handling of both patients and instruments.

In contrast to the light provided by normal lamps, not only the brightness but also the colour reproduction is considerably better when using halogen lamps, so it is then possible to recognize important diagnostic color nuances more easily. These lamps can be switched off independently of the heating in order not to dazzle the child unnecessarily.

The controls for the radiant heater are located in a housing attached to the side. The inside of this housing, in other words the side facing the user, is provided with touch-sensitive controls featuring all display and input components. The control system is such that it is possible to enter both fixed heating-power values by hand ("Man" -mode) and to effect automatic regulation in line with a specified skin temperature ("Auto" mode). Both modes feature . comprehensive warning facilities and check routines for monitoring the patient concerned. An additional integrated feature is a stop watch which - on being started when a child is born - gives an audio indication of the times of relevance for the Apgar test (1 min., 5 min. and 10 min.).

1.1.3 Skintemperature regulation

The regulator keeps the child's temperature at the set desired level by way of appropriate adjustment of the heating power. The system deviation which can be achieved in this manner is only a few tenths of a °C.

Regular checks must be carried out to ensure that the skin-temperature sensor is properly attached to the child. If the sensor were to work loose from the skin, this would mean that measurements would no longer be taken of the skin-temperature, but rather of the ambient temperature.

The skin-temperature sensor in conjunction with the radiant heater is an electric thermometer for determining the temperature of the human body.

1.2 Functional description

1.2.1 Description of input elements

1.2.1.1 Mains switch

The mains switch is used to switch the primary voltage off or on. At the same time, an auxiliary contact on the secondary side serves to generate the power-failure alarm.

1.2.1.2 Light switch

The light switch switches the 12 V secondary voltage to the lamp(s).

1.2.1.3 Desired-temperature adjustment

The desired temperature can be adjusted in increments of 0.1 between 35.0 °C and 37.0 °C. Adjustment is effected using the buttons on either side of the desired-temperature display. The buttons are only effective if a desired temperature is being displayed, i.e. in automatic mode. After switching to automatic mode, the desired-value display flashes until the setting is acknowledged by briefly pressing one of the adjustment buttons. A value of 36.3 °C is pre-set on commissioning.

1.2.1.4 Bargraph adjustment

The bargraph, which symbolizes the set heating power, can be adjusted in increments of one between 1 and 10. Adjustment is effected with the buttons on either side of the bargraph display. These are only effective if the bargraph is being displayed, i.e. in manual mode. After switching to manual mode, the bargraph flashes until the setting is acknowledged by briefly pressing one of the adjustment buttons. Setting 5 is effected on commissioning. The bar of setting 5 lights up more brightly than the others.

1.2.1.5 Timer

The timer is designed in particular to monitor the first few minutes of a new-born baby's life. It is started by means of the "start" button to the left of the timer display. Pressing the "stop/reset" button for the first time on the right of the display stops the timer. Pressing the stop button again resets the timer to "0.00". If, instead of the above, the start button is pressed again, time recording is continued without prior zeroing.
An audio signal consisting of three short bleeps, which cannot be affected by the alarm tone suppression, is given after the 1st the 5th and the 10th minutes. Following completion of 99

minutes and 59 seconds, the display returns to "0.00" and starts again, however without the bleeps.

1.2.1.6 Automatic mode - manual mode

Following switch-on, the unit is in manual mode, heat setting 5, and the pre-set desired temperature is 36.3 °C if more than 5 minutes have passed since the preceding shutdown. If operation is interrupted for less than 5 minutes, the last valid setting is taken over. In the first instance, the bargraph flashes whilst awaiting the final setting, whereas in the second situation the flashing mode is suppressed. This function is of benefit in the event of a brief interruption of the power supply or inadvertent switch-off on actuating the lamp switch. The desired-value display likewise flashes after changing modes until the set value is acknowledged or adjusted. Acknowledgement takes the form of initial actuation of a button for adjusting the corresponding desired value. After switching to "Man". the bargraph thus flashes until it is acknowledged, whereas when switching to "Auto" the desired-temperature display flashes until acknowledgement is given. The heating power can be adjusted in automatic mode between 1 and 10. The set heating power is displayed by way of corresponding bars in a bargraph. Given settings between 6 and 10, an audio warning signal is triggered every 15 minutes, with this being reset again by way of the "Reset 15 min." button. Pressing the "Auto" button causes the unit to assume the automatic mode. The desired-temperature display is activated with the last set value and the bargraph display goes out. After switching modes, the desired-temperature display flashes until the value is acknowledged by pressing an adjustment button. A sensor alarm is given immediately if no sensor is connected. A temperature deviation alarm is given if a sensor is present, but the temperature deviation is greater than 0.5 °C. The following heat settings can be encountered in automatic mode.

Actual temperature = Desired temperature -0.2 °C or lower	= Heat setting 10
Actual temperature = Desired temperature -0.1 °C	= Heat setting 7
Actual temperature = Desired temperature	= Heat setting 5
Actual temperature = Desired temperature +0.1 °C	= Heat setting 3
Actual temperature = Desired temperature +0.2 °C or higher	= Heat setting 0

1.2.1.7 Alarm-tone suppression for 10 minutes

If an audio alarm sounds, which can be attributed to a temperature deviation or sensor malfunction, it can be suppressed for 10 minutes by pressing the alarm-tone suppression button. If the alarm is cleared during this period, the alarm-tone suppression is deactivated again. This is likewise the case if another alarm additionally occurs during this time. An audio alarm, which is generated by equipment failure, or mains failure cannot be deactivated. If the processor detects system failure, a corresponding error message appears on the timer display.

1.2.1.8 Button Check 36 °C

Switching to a calibration resistor in the unit is effected by the sensor resistor if the button "Check 36 °C" is pressed. The temperature deviation alarm is suppressed on account of the fact that the skin temperature is not known whilst the button is being pressed. This suppression feature remains active for 0.5 seconds after releasing the button, so as to cover the possible occurrence of a measurement error when switching back to the sensor. If this button is pressed for more than 15 seconds, then a sensor alarm is given. NO new heating pulse is triggered whilst the button is being actuated. A heating pulse, which is active on pressing the button is however not influenced.

1.2.1.9 15 minute reset

If the unit is in manual mode, and if a heat setting between 6 and 10 has been selected, an audio alarm, which is accompanied by a flashing LED in the button "15 minute reset", is triggered after completion of a 15 minute period. Pressing this button resets the alarm for the next 15 minutes. The alarm is deactivated if the heat setting is adjusted to values below 6.

1.2.1.10 Setting mode for built-in clock

The time which has elapsed since the last start-up is calculated with the aid of a built-in clock. In order to start the clock on final inspection, a setting mode has been introduced. This is attained by pressing the "start" button with the "check" button pressed. The setting mode makes use of the timer display panel. The next adjustment steps are obtained with the "start" button. Exit from the setting mode is effected again with the "stop/reset" button. The first phase is used for time indication. Adjustment is not possible. In the subsequent phases, the displayed value can be adjusted by way of the bargraph adjustment data. The following phases are run through:

Display example	Function
20.30	Time indication, Hours : minutes
A-89	Annee - Year
M-07	Month
J-14	Jour - Day
S-05	Semaine = Day of the week
C-00	Code for running time correction
h-20	heure = Hour
m-30	Minutes

If exit from the day.(J) setting is effected with the "start" button, the hour setting follows; if, on the other hand, exit is effected with the "check" button, steps "S" and "C" are inserted (pay attention to decimal point in display for this item!). The seconds are set to 0 on leaving the

minute setting with "start"; the new setting becomes valid and the first phase (time indication) is activated. The clock is not adjusted on effecting exit with "stop/reset".

1.2.2 Description of display elements

1.2.2.1 Temperature deviation

If there is a temperature deviation of more than 0.5 °C in automatic mode, the LED "temperature deviation" flashes together with the measured-value display. If the accompanying audio alarm is suppressed using the corresponding button, the LED lights up continuously. The LED in the alarm-tone suppression button also lights up. The measured-value display continues to flash. An excess-temperature alarm, continuous tone, which is accompanied by a is given as of a sensor temperature of 38.8 °C irrespective of the set mode.

1.2.2.2 Sensor LED

This LED is used to indicate a sensor problem. Such a problem may be that no sensor is connected in automatic mode, that the sensor or the evaluation circuit is defective, that the sensor is too hot or that the sensor has had a temperature of less than 32.3 OC in automatic mode for more than 10 minutes.

1.2.2.3 Heating LED

This LED lights up when the heating current is switched on. In view of the fact that the heating current is pulsed, it is thus normal for this LED to flash.

1.2.2.4 Inop LED

This LED lights up if the unit is inoperative. The acoustical alarm sounds at the same time in the event of equipment failure.

1.2.2.5 Power-failure LED

This LED lights up in the event of power failure or processor malfunction. The audio alarm sounds at the same time. In the event of a mains failure, this function is supplied by a built-in rechargeable battery which is charged again during operation.

1.2.2.6 Error codes

The unit continuously executes self-tests. If an error is established in the course of such tests, an error code appears in the timer display panel and is accompanied by the INOP-LED and an audio alarm. The error codes take the form "Err X" with X standing for a number between 1 and 0.

Error 1	-	ROM error
Error 2	-	RAM error
Error 3	-	Safety relay defective
Error 4	-	Semiconductor relay defective
Error 5	-	No current through heating
Error 6	-	Undefined
Error 7	-	Reference voltage defective
Error 8	-	Voltage setting not plausible

1.2.2.7 Display of Software Version

The version number of the software is indicated in the timer display panel if the two buttons for the timer ("start" and "stop/reset") are pressed simultaneously.

1.2.3 Temperature measurement

The lower temperature limit for the measurement circuit is 32.3 °C. If the sensor temperature is less than the above figure, an alarm with a continuous tone is given in automatic mode after 10 minutes and the red LED "sensor" lights up. At the same time, the center lines in the measured value display start to flash. In the event of a measured value less than 33 °C, the lower bars are superimposed on the measured value display. The measured value indication is then given above this up to a figure of 38 °C. The upper bars are superimposed on the display if the measured value exceeds 38 °. An excess-temperature alarm is given as of 38.8 °C (corresponding to 1260 ohms). If the temperature continues to rise and the resistance therefore drops as a result to roughly 1140 ohms (corresponding to 41.3 °C), a sensor alarm is given and the center bars flash. A sensor short-circuit is one example of such a situation. In the event of a cable break, the same display is given and the same alarm triggered by the sensor monitoring circuit. If a sensor break is detected, the heating is switched off in addition to indication of the sensor alarm (audio and visual).

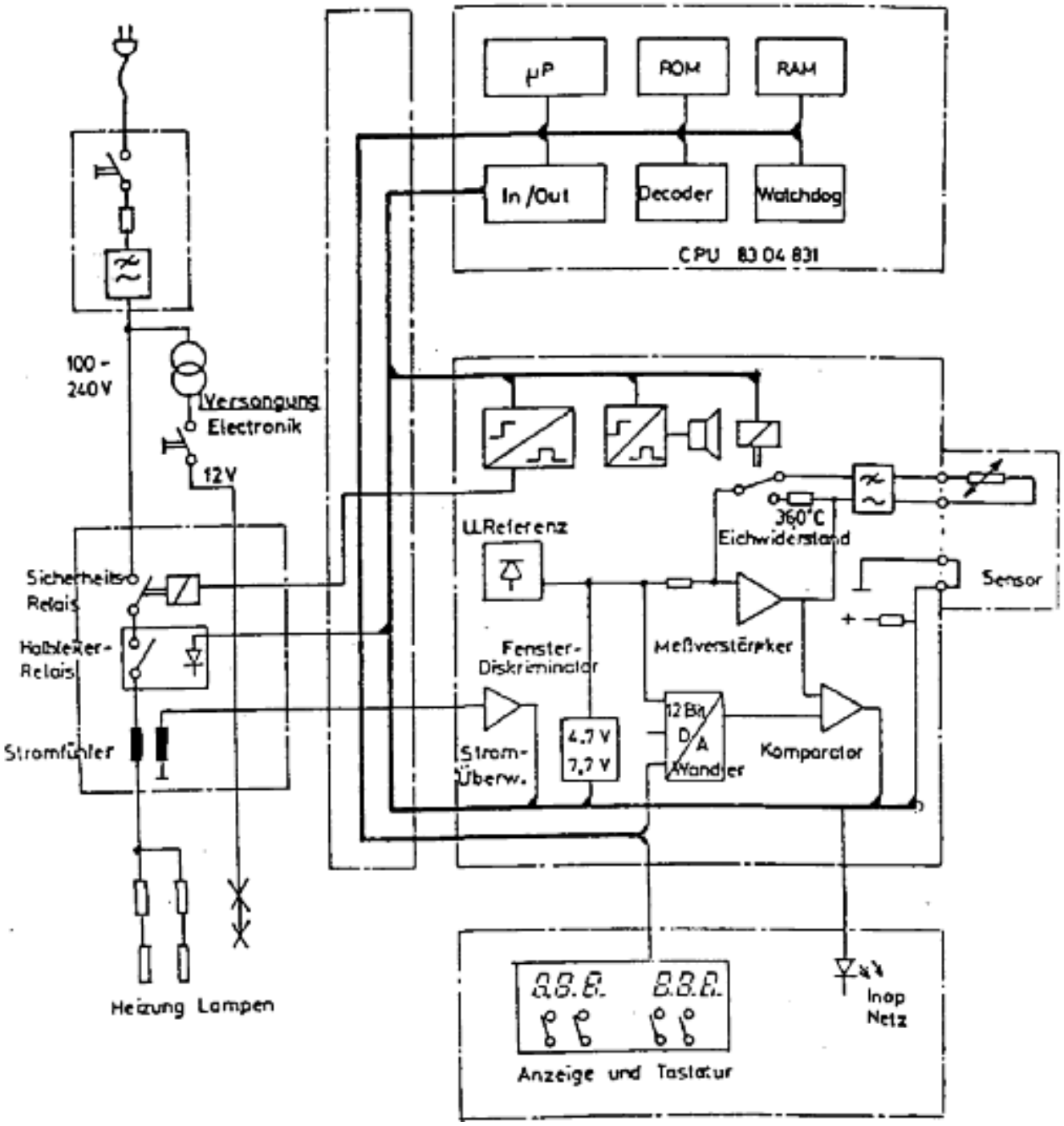
1.2.4 Heating control

The heating resistors are clocked in a 2 second rhythm. The power is a function of the pulse duration which can be between 0 ms and 1996 ms. The corresponding duration is to be taken from a table in line with the operating voltage set by way of the option switches and the heat setting currently being employed. The current is checked by the processor by means of a

current transformer. If the current fails, error 5 is activated. If a flow of current is detected in the non heating phases, error 4 is activated.

2 Description of Signal flow

2.1 Block diagram



2.2 Description of function blocks

Microprocessor

The microprocessor 6802 from Motorola controls the entire functional sequence of the unit. The main functions are power control and regulation of the heating, temperature measurement with monitoring and alarm signaling, display, keypad evaluation, timer and self-monitoring.

ROM

The ROM used is an E-PROM 27256.

RAM

Time keeper RAM MK48T02B with timer.

Port

PIA 65SC22 with 20 in/out lines as well as timer. 74HC273 with 8 outputs.

Watchdog
2 independent watchdogs (BG + IRQ) based on 74HC4060 as well as 5 V monitoring.

Measurement circuit
A 6.2 V reference diode serves as reference voltage source for the measurement circuit and for a D/A converter. The first operational amplifier stage supplies a voltage proportional to the sensor resistance. This voltage is amplified in a second stage and shifted into the dynamic range with the aid of the reference voltage. This signal is passed to one input of a comparator, with the other input being connected to the output signal of the D/A converter. The comparator output is read by the microprocessor, which thus controls the measured-value determination in line with the successive approximation method.

2.3 Safety features

2.3.1 Heating circuit monitoring

Following switch-on, the heating control is tested and in particular the safety relay is subjected to a functional test. This test is not normally repeated during operation. If, however, a fault occurs in the heating circuit, and this fault is detected during operation, then the complete test

is repeated every 10 seconds until a fault-free condition is recognized. The following tests take place:

- Interrupt function of safety relay after starting only and, if applicable, in repeated complete test. (Err. 3)

- Interrupt function of semiconductor relay after starting and during all pulse pauses with a duration of more than 36 ms. (Err. 4)

- Testing of heating circuit for current flow after starting and during all heating pulses with a duration of more than 24 ms. This error can also be caused by a fault in the current monitoring. (Err. 5)

The error "interruption of heating circuit" is also recognized if, on account of another INOP error, the safety relay is switched off and thus leads to the interruption. The display for error no. 5 thus has the lowest priority, i.e. if several errors are recognized at the same time, the others are always indicated first. This means that if "Err 5" is being displayed, then this is the only error or follow-up error (still) present. On the other hand, a detected error automatically switches off the safety relay. Exit from this situation of mutual error assignment can only be effected by way of the complete test. Errors 3, 4 and 5 all trigger this complete test with the next internal 10 second clock.

2.3.2 Recognition of connected sensor

A shorting link in the sensor plug makes it possible to recognize whether a sensor is connected or not. If this is not the case, an alarm is triggered in automatic mode.

2.3.3 Recognition of sensor break

The monitoring circuit with transistor 5 from the transistor array IC4 monitors the output of the measurement amplifier 1. If this transistor starts to conduct with a connected sensor, an alarm is triggered. This is the case as of a sensor resistance of approximately 15 k Ohms.

2.3.4 Recognition of sensor short circuit

The sensor resistance decreases with increasing temperature. At roughly 1140 ohms, the voltage of stage 2 exceeds the value range of the D/A converter. If this condition is satisfied, an alarm is triggered irrespective of the mode of operation.

2.3.5 Reference voltage monitoring

A window discriminator has the task of monitoring the reference voltage. If this voltage departs from the permitted range between 4.7 and 7.7 volts, a low signal appears at the port line PA4. The alarm "sensor INQP" is then triggered if a sensor is connected.

2.3.6 Audio alarm

A mono flop must be constantly triggered, in order to deactivate the audio alarm-tone generator. Such triggering fails if the microprocessor detects incorrect operation or if the microprocessor system is no longer functioning properly.

2.3.7 INOP-LED

The INOP-LED indicates that the unit is not functioning. If the microprocessor is operating, it controls this LED in line with the results of the equipment test; if the microprocessor fails, the LED is activated by the reset signal of the watchdog. PC1 = low => LED lights up.

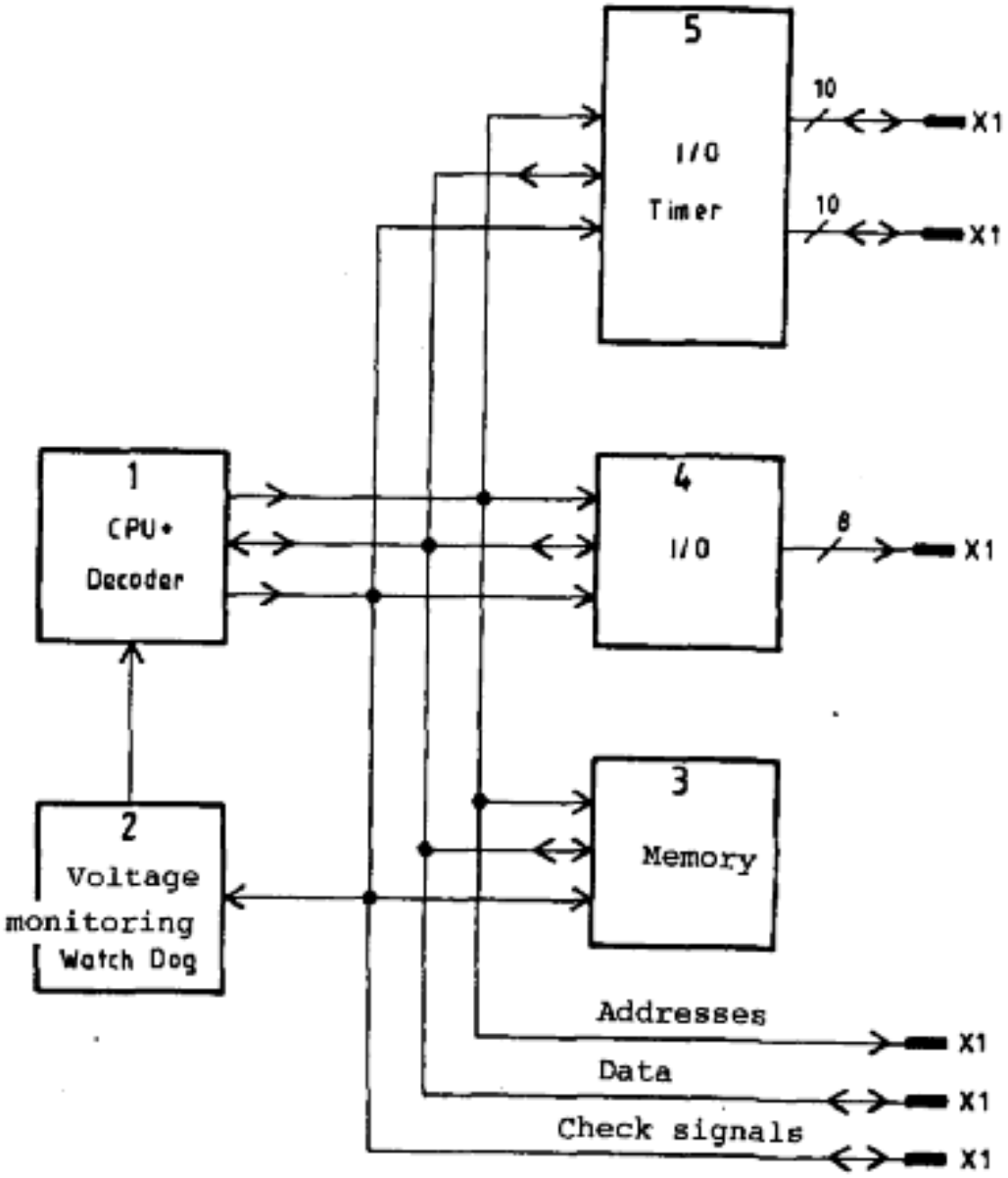
2.4 Detailed description of the assemblies

2.4.1 CPU PCB

2.4.1.1 Intended use

The assembly is a universal microprocessor assembly based on the microprocessor 6802.

2.4.1.2 Block diagram



2.4.1.3 Functional description

Block 1 contains the CPU (microprocessor 6802) with clock oscillator and address decoding. The voltage monitoring and the watchdog in block 2 generate the reset signal for the system. The memory (block 3) consists of the program memory (max. 32 k byte EPROM) and the data memory (max. 8 k byte RAM). The I/O block 4 makes 8 bits available as output. The VIA 6522 . contained in block 5 makes 2 B-bit ports available, the individual lines of which can be programmed separately as inputs or outputs. Each port also has 2 check lines which can be utilized as handshake lines. The VIA likewise features 2 timers and 1 shift register. The signals of the microprocessor bus are buffered and passed to the connector X1.

2.4.1.4 Description of circuitry

The assembled p.c. board "CPU" is a microprocessor system configured using the microprocessor 6802. The system features a data memory area of max. 8 k bytes as of address 0000h and a program memory area of max. 32 k bytes as of address B000h. In addition to the peripheral modules, it contains voltage monitoring and watchdog logic. Operating voltage is applied to the address, data and control lines of the CPU by way of pull-up resistance networks, in order to achieve level matching with respect to the following HCMOS modules. Address decoding is realized with the modules D5, D6, D7, D10, D14, D15 and D16. The EPROM D2 is selected by means of the signal Al5 VMA-Q, i.e. it is activated via addresses B000h to FFFFh. The decoder D2 decodes A12, A13 and A14 in the 0000h to 7FFFh range. Y0, Y1 and E are linked to form the signal CSRAM-Q. This signal is activated when the addresses 0XXXh and 1XXXh are addressed. Y2 is linked with R/W-Q and the addresses A0 to A11 such that the watchdogs can only be activated by writing into the addresses 2FFEh/2FFFh. Y3 is used together with the address lines A0, A1, A2, A3 and A11 to select the I/O ports D4 (address 3800h to 380Ah) and D17 (address 3000h).

Y4, Y5, Y6 and Y7 select the address areas 4XXXh, 5XXXh, 6XXXh and 7XXXh and can be employed for an external I/O or memory. All bus signals passed to the connector X1 are buffered by the drivers D11 and D13. The data driver D13 is only activated if the external address areas 4XXXh to 7XXXh are addressed.

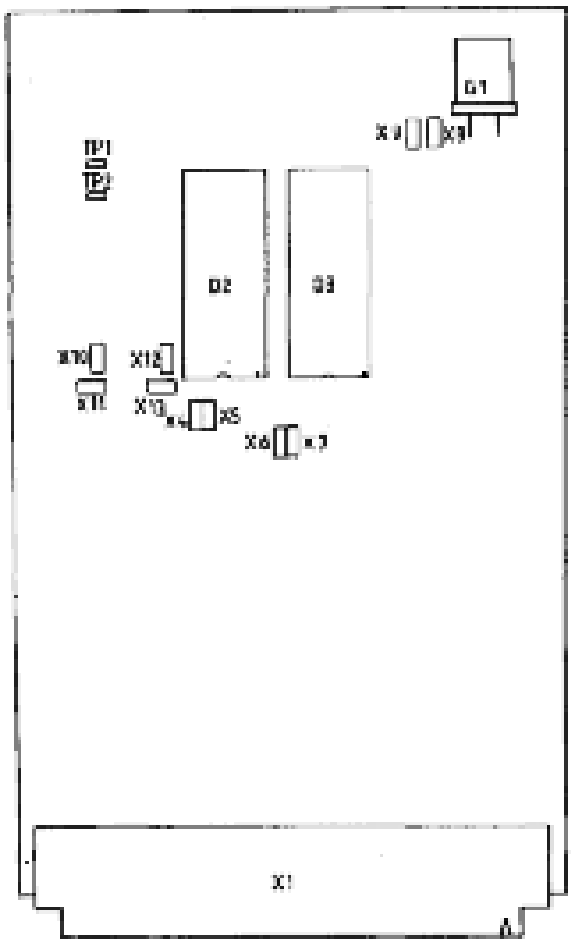
Assignment of address areas:

Module/signal	Address	Status
EPROM 2764	8000h to 9FFFh	(R)
	A000h to BFFAh	(R)
	C000h to DFFFh	(R)
	E000h to FFFFh	(R)
EPROM 27128	8000h to BFFFh	(R)
	C000h to FFFFh	(R)
RAM 5516	0000h to 07FFh	(R/W)
RAM 5564	0000h to 1FFFh	(R/W)

Watchdog D8	2FFEh	(W)
Watchdog D9	2FFFh	(W)
Port D17	3000h	(W)
VIA D4	3800h to 380Ah	(R/W)
Y7	7XXXh	
Y6	6XXXh	
Y5	5XXXh	
Y4	4XXXh	

The module N1 monitors the operating voltage and generates a reset pulse for the CPU D1. Following switch-on of the 5 V supply voltage, the capacitor of the RC element R14/C22 is initially still discharged. As long as the 5 V supply voltage is < 4.8 volts, the output OUT2 of N1 remains on LOW. The capacitor C22 remains connected to earth via V1 and R30. OUT2 only switches to HIGH level and C22 is thus only charged by way of R14 when the 5 V supply voltage is > 4.8 V. The buffered RAM D3 is activated by way of V8. The 5 V operating voltage is switched to VccRAM and thus also to the RAM D3 by means of V6 and V7. As soon as the voltage at C22 exceeds the internal reference voltage of N1 (approx. 1.3 V), the RESET pulse at OUT1 is terminated and the CPU can start. If the operating voltage dips below 4.75 volts, the RAM is blocked and a RESET pulse is triggered. The watchdog logic consists of the two time generators D8 and D9 and the address decoding by way of parts of the modules D14, D15, D16 and D10. The time generators D8 and D9 feature an internal oscillator circuit with an oscillation frequency of approximately 100 kHz. HIGH signals, which are applied to D16 and generate RESET pulses, appear at the outputs Qk some 80 ms following the last zero crossing of the counter chain. The two time generators must therefore receive reset pulses in good time by writing into the addresses 2FFEh (D9) and 2FFFh (DE) if no CPU RESET is to be triggered.

2.4.1.5 Layout



2.4.1.6 Configuration of EPROM D2 and RAM D3

Use can be made of 8 k byte, 16 k byte, 32 k byte or 64 k byte EPROMS. Jumper X4 or jumper X5 is to be positioned depending on EPROM selection.

D2: EPROM	Type	X4	X5
8 k Byte	2764	X	
16 k Byte	27128	X	
32 k Byte	27256		X
64 k Byte	27512		X

X = Jumper connected

Connected for type 27256 in radiant heater RH600.

Either an 8 k byte or a 2 k byte RAM can be used for D3.

D3: RAM	Type	X6	X7	X8	X9
2 k Byte	5516	X		X	
8 k Byte	5564		X		X

X = Jumper connected

Connected for 2 k bytes in radiant heater.

2.4.2 Logic PCB

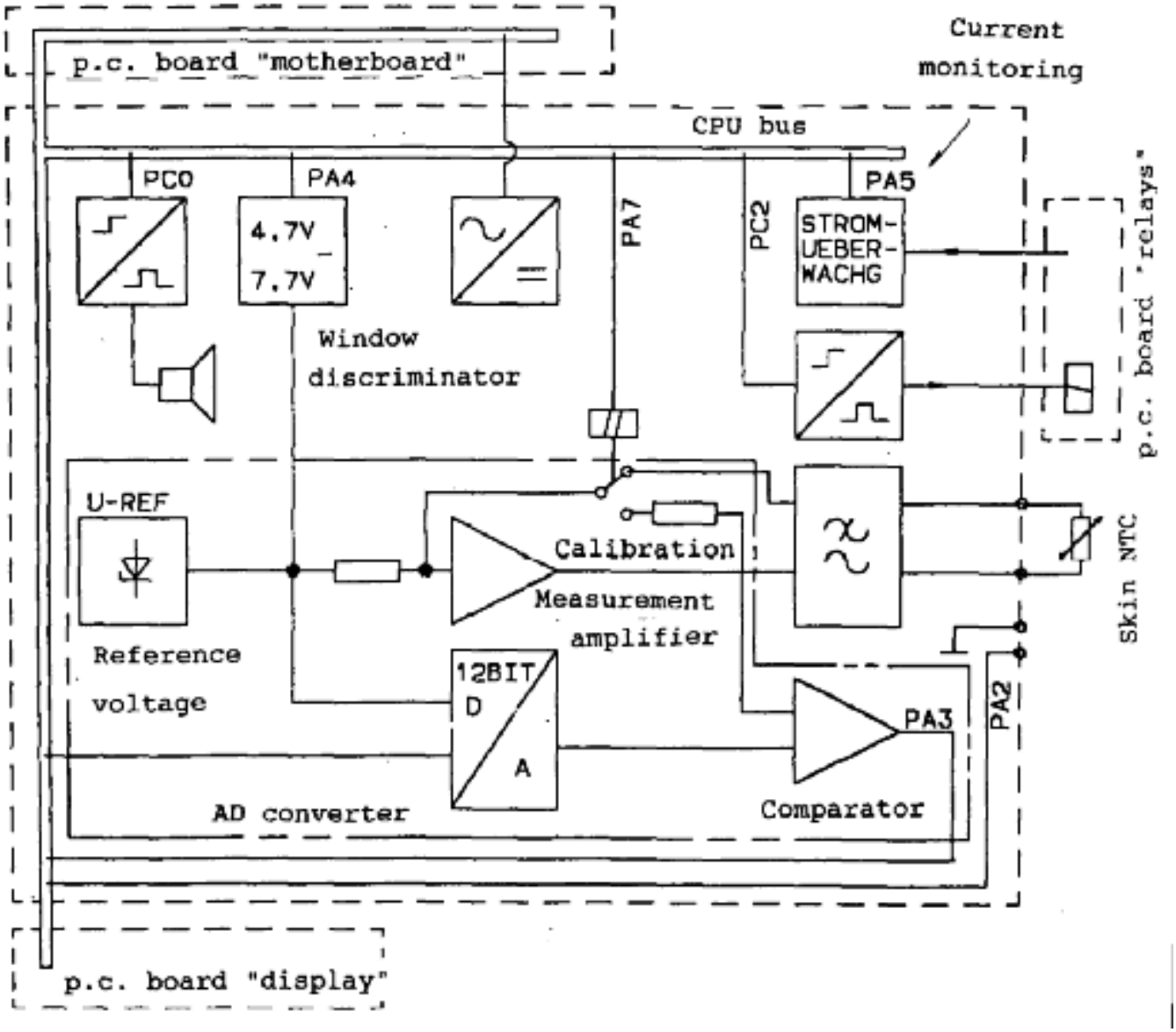
2.4.2.1 Intended use

The Logic PCB features the following function blocks:

Discrete AD converter with corresponding measurement amplifier for skin-temperature measurement

- Signal generator with actuation circuit
- Evaluation circuit for current monitoring of heating
- Rectifier circuit for +5 V, +15 V, -15 V and +24 V
- Voltage regulator for +15 V and -15 V
- Mains operating voltage adjustment by way of DIP switch

2.4.2.2 Block diagram



2.4.2.3 Description of circuitry

a) AD converter
b) Window comparator
c) Current monitoring
d) d.c. voltage
e) Mono flops
f) DIP switches

a) AD converter
The 6.2 V reference diode serves as reference voltage source for the measurement amplifier and for the D/A converter. The external sensor NTC is located in the negative feedback loop of the measurement amplifier. External interference is suppressed by way of the low-pass filter. The measurement signal is supplied to the comparator. The second input of the comparator is connected to the output of the D/A converter. The comparator output is read by the microprocessor which controls the D/A converter in line with the principle of successive approximation. If necessary, the measurement amplifier can be switched to an internal reference resistor (36 °C).

b) Window comparator
The window comparator monitors the reference voltage within the limits 4.7 V to 7.7 V, in order to guarantee that the A/D converter is functioning properly.

c) Current monitoring
If mains voltage is applied to the reactor on the Relay PCB, the 50/60 Hz signal is applied to the current monitoring. The signal switches a comparator in the 50/60 Hz cycle. The output of the comparator is read by the processor.

d) d.c. voltaae supply
The p.c. board accommodates two rectifiers:

1) for 5 V
2) for +15 V, -15 V and +24 V

The voltage regulators for +15 V and -15 V are integral components of the p.c. board. The voltage regulator for +5 V is attached to the sheet-metal bracket for the 9 Volt measurement and there is no voltage regulation for 24 V.

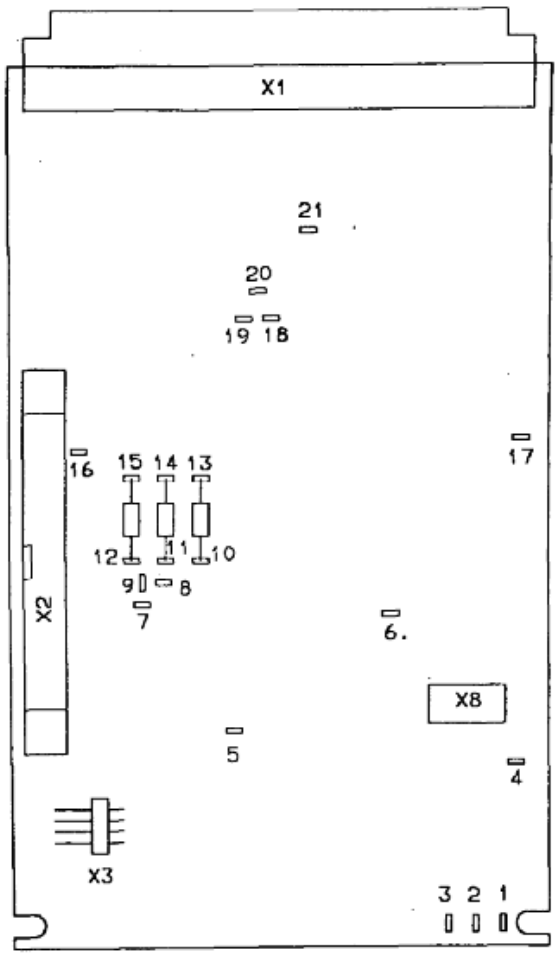
e) Mono flops
The two monoflops are cyclically retriggered by the processor. The first mono flop is used for the safety relay; the second mono flop keeps the horn silent.

f) DIP switches
As regards switches S1/1 - S1/8, only one may be switched on. The switch setting controls the heating power by way of the pulse/pause ratio.

Switch S1	**Function**
1	no function
2	no function
3	no function

4	100 V
5	110 V
6	127 V
7	220/230 V
8	240 V

2.4.2.4 Layout



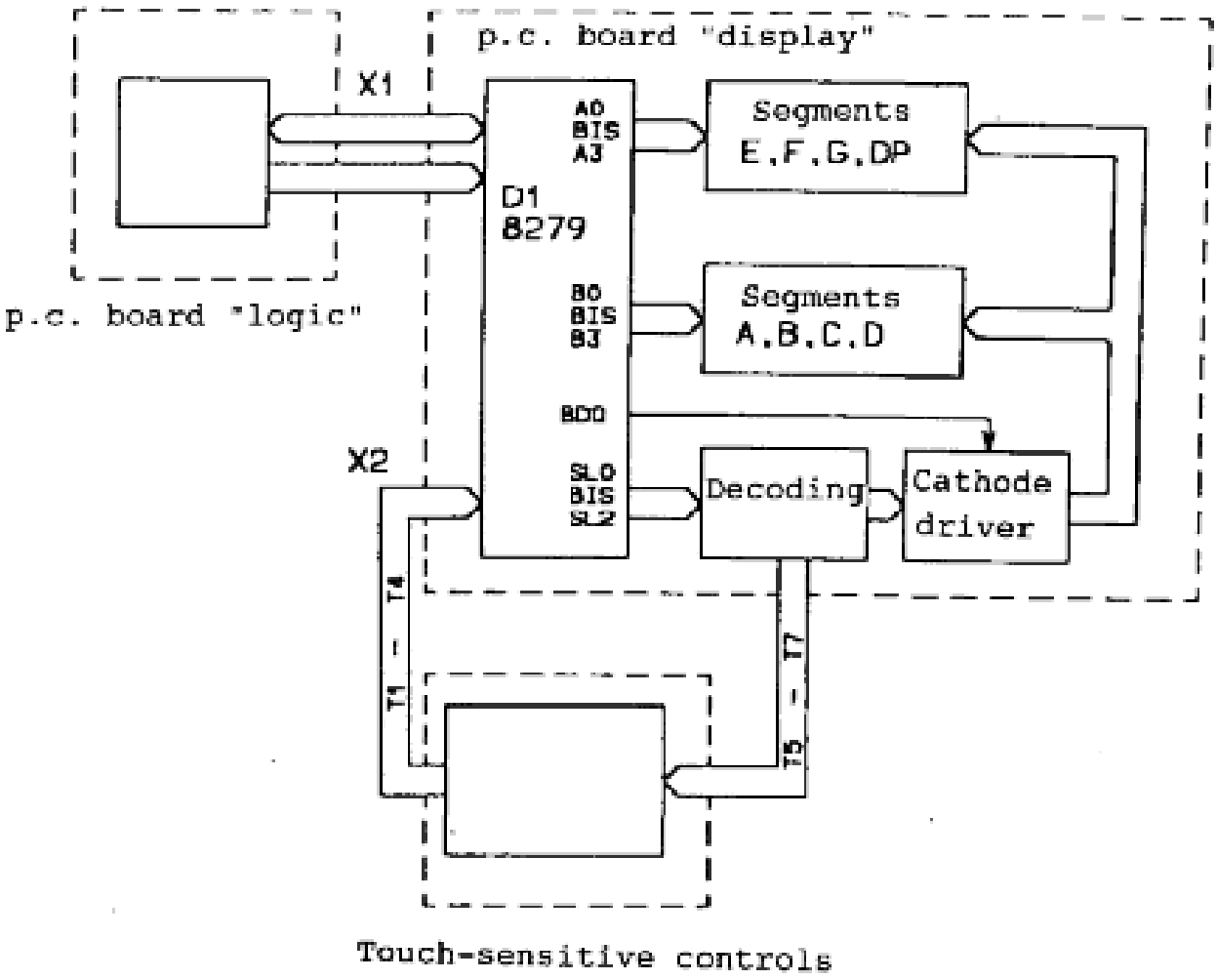
X1 Connection, Motherboard PCB
X2 Connection, Display PCB
X3 Connection, skin-temperature sensor socket
X8 Connection, rechargeable battery

2.4.3. Display PCB

2.4.3.1 Intended use

The Display PCB is used to indicate the heating power, the desired and actual temperatures, the time function and the date function. Furthermore, alarm and operating statuses are indicated by way of various light-emitting diodes in addition to interrogation of keypad events.

2.4.3.2 Block diagram

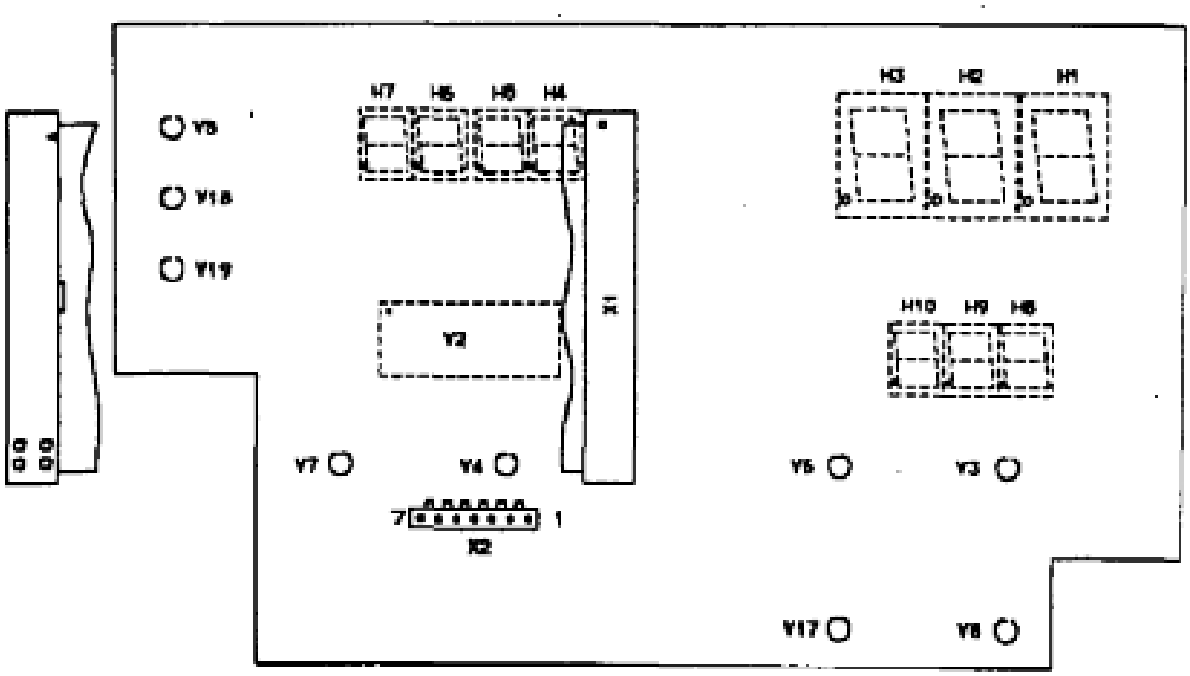


2.4.3.3 Detailed description of function blocks

The programmable keypad and display interface module 8279 (D1) is responsible for display control on the Display PCB. Output is effected in multiplex fashion. The ports A0 - A3 and B0 - B3 are actuated as an 8-bit channel; column scanning of the displays is effected via the ports SL0 - SL2 and the decoder (D2).

The cathode drivers are selected by way of the ports SL0 and SL1 as well as BDQ (refer to block diagram). The bulk resistances for actuating the LED bargraph are 464 Ohm. An exception is R23 with 301 Ohm. The reason for this is that the center bar is displayed more brightly.

2.4.3.3 Layout

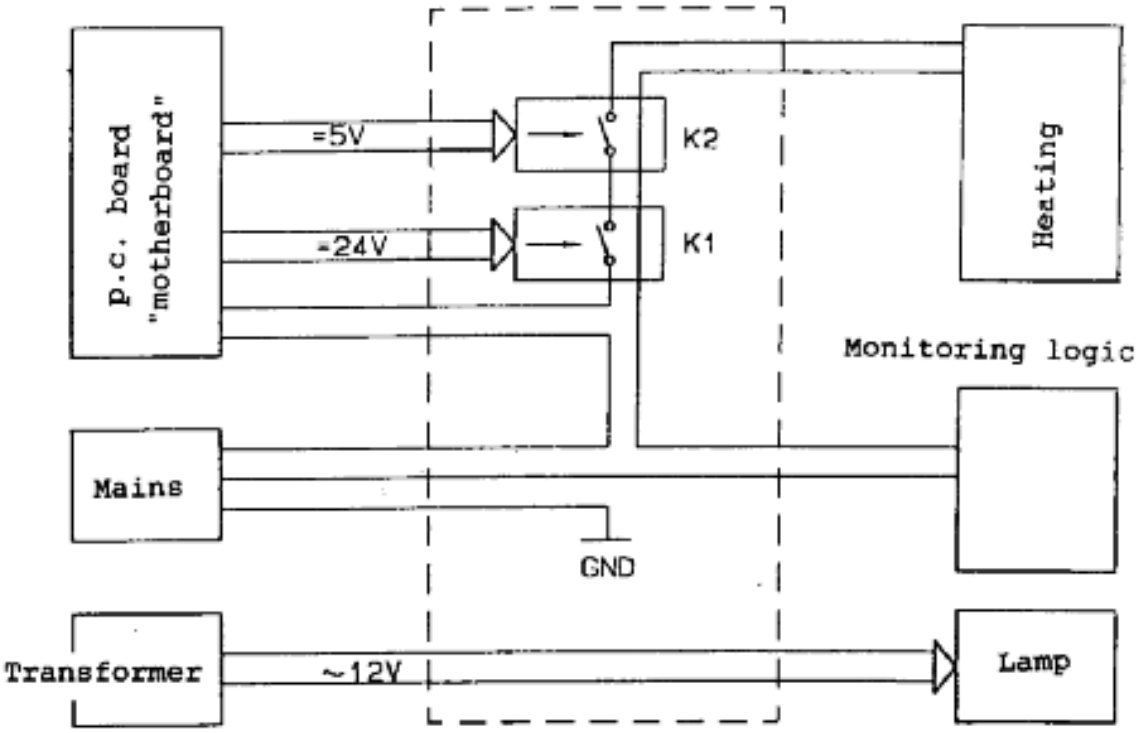


2.4.4 Relay PCB

2.4.4.1 Intended use

The Relay PCB switches the heating lamps by way of external control signals from the Logic PCB. A check is made via a current/voltage transformer as to whether current is flowing through the heating lamps.

2.4.4.2 Block diagram



2.4.4.3 Functional description

Semiconductor relay K2:
The semiconductor relay K2 controls the heating lamps. The heating power is set by way of the pulse/pause ratio. The actuation voltage is 5 V.

Safety relay K1:
For safety reasons, the safety relay K1 is connected in series in the primary circuit of the semiconductor relay K2. The actuation voltage is 24 V.

2.4.4.4 Layout